

## INTERFACE APPARATUS AND METHOD THEREOF FOR DISPLAY SYSTEM

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention relates to an interface apparatus and a method thereof for a display system, and in particular to an interface apparatus and a method thereof for a display system which are capable of displaying an image and a text on a screen of a LCD (liquid crystal display) and minimizing a power consumption when a LCD (liquid crystal display) system is in a standby state.

#### 2. Description of the Prior Art

Generally, a LCD (liquid crystal system) system such as an IMT-2000 (international mobile telecommunications 2000) compressing video data, restoring it and displaying it on a screen of a LCD is constructed with a main CPU (central processing unit), a video codec and a LCD (liquid crystal display) driver. Herein, the LCD system is operated as an active mode, a standby mode and a power down mode. The active mode means a normal operation mode, the standby mode means a standby state, and the power down mode means a state displaying nothing on a screen of a LCD but being ready for a display.

However, because the LCD system according to the prior art operates a video codec in a standby mode, it consumes lots of power unnecessarily. In more detail, when the video codec is operated in the standby mode of the LCD system in accordance with the prior art, power is unnecessarily consumed 20 times larger than the power consumption when the video codec is not operated.

## SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an interface  
5 apparatus and a method thereof for a display system which are capable of  
minimizing a quantity of power consumption in a standby state of a display system  
by displaying an image (an animation, a still image and a text) and a text through  
an I2C (IIC) interface of a main CPU by not operating a video codec in a standby  
mode of the display system.

10 In order to achieve the above-mentioned object, an interface method for a  
display system includes outputting data including an image and a text, being  
inputted the data through an I2C interface in a standby mode and displaying the  
image and text on a screen, and being inputted the data through a video codec in  
an active mode and displaying the image and text on the screen.

15 In order to achieve the above-mentioned object, an interface apparatus for  
a display system includes a main CPU outputting data including an image and a  
text according to an operation mode of a system, a video codec being inputted the  
data and outputting it by interfacing with the main CPU according to the operation  
mode, and a driver being inputted the data through the video codec or being  
20 inputted the data from the main CPU through the I2C interface in accordance with  
the operation mode and displaying the image and text on the screen.

In order to achieve the above-mentioned object, in a method transmitting  
data to a memory of a LCD (liquid crystal display) driver through an I2C interface  
of a main CPU of a mobile communication terminal and writing the data, an  
25 interface method for a display system includes outputting sequentially a byte for

slave address, a byte for mode setting and a byte for pixel data when the data is burst data, outputting sequentially a byte for slave address, a byte for mode setting, a byte for area start address, a byte for area end address and a byte for pixel data when the data is area data, outputting sequentially a byte for slave address, a byte for mode setting, a byte for line address, a byte for pixel data when the data is line data, and outputting sequentially a byte for slave address, a byte for mode setting, a byte for pixel address and a byte for pixel data when the data is pixel data in order to write the data in the memory.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1A is a block diagram illustrating an interface apparatus of a LCD (liquid crystal display) system in accordance with the present invention;

Figure 1B illustrates an operation mode and a display scheme in accordance with the present invention;

Figure 2 is a block diagram illustrating a memory unit in accordance with the present invention;

Figure 3 is a format view illustrating a mode setting in accordance with the present invention;

Figure 4 illustrates an expression example about each data in accordance with the present invention;

Figure 5 is a block diagram illustrating a memory unit for an animation mode in accordance with the present invention;

Figure 6 is a block diagram illustrating a memory for a still image and a text display mode;



Figure 7 is a block diagram illustrating a memory only for a text display mode;

Figures 8A ~ 8H illustrate data formats about a method for writing data in OSD memories according to control of a main CPU of a LCD system; and

Figure 9 is a write format view illustrating register control data in order to describe a method for writing register control data.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, preferred embodiments of an interface apparatus and a method thereof for a LCD (liquid crystal display) system in accordance with the present invention which are capable of displaying an image (animation, still image, text) and a text on a screen of a LCD (liquid crystal display) through an I2C (IIC) interface of a main CPU without operating a video codec in a standby mode will be described in detail with reference to accompanying Figures 1 ~ 9.

Figure 1A is a block diagram illustrating an interface apparatus of a LCD system in accordance with the present invention.

As depicted in Figure 1, an interface apparatus of a LCD system in accordance with the present invention includes a main CPU (Central Processing Unit) 11 outputting data having an image (still image, moving picture, animation) and a text to a LCD driver 13 through a video codec 12 in an active mode of a LCD system and outputting pertinent data (data having an image or a text, etc) to the LCD driver 13 by using an I2C interface in a standby mode of the LCD system, a video codec 12 being inputted data having a still image, a moving picture, an animation, a text from the CPU 11 and outputting it to the LCD driver 13 in the

active mode, and a LCD driver 13 being inputted data through the video codec 12 in the active mode, displaying the image and text on a screen of the LCD, being directly inputted the data from the main CPU 11 in the standby mode and displaying the image and text of the data on the screen of the LCD. First, the LCD system is operated as three modes such as an active mode, a standby mode and a power down mode. The operation of the interface apparatus for the LCD system in accordance with the present invention will be described in detail with reference to accompanying Figures 1B ~ 9.

Figure 1B illustrates an operation mode and a display scheme in accordance with the present invention. In more detail, Figure 1B illustrates the operation of the three modes (active mode, standby mode, power down mode) and the display scheme.

As depicted in Figure 1B, the main CPU 11, the video codec 12 and the LCD driver 13 operate normally in the active mode. Herein, data such as an image (a still image, a moving picture, an animation) and a text, etc. is inputted to the LCD driver 13 through the video codec 12 at 30 frames per second, and the LCD driver 13 displays the inputted data on the screen of the LCD at 30 frames per second.

The standby mode is set when a key signal is not inputted for a certain time. Herein, a text can be displayed with a simple animation or still image as a background or only text can be displayed in the standby mode. Instead of it, the main CPU 11 transmits the data to the LCD driver 13 at 5 frames per second by using the I2C interface and stores it in a memory unit (example: SRAM) 13B of the LCD driver 13, and a LCD controller 13A of the LCD driver 13 displays the data stored in the memory unit 13B on the screen of the LCD at 5 frames per second.

The power down mode means nothing is displayed on the screen of the LCD but the LCD system is ready for displaying.

Figure 2 is a block diagram illustrating the memory unit in accordance with the present invention. In more detail, Figure 2 is a block diagram illustrating the memory of the LCD driver 13.

As depicted in Figure 2, the LCD driver 13 stores the data (serial data) transmitted from the main CPU11 through the I2C interface in a serial buffer 21 first and stores it in OSD (on screen display) memories 22, 23 constructed as a parallel format. Herein, while the main CPU 11 writes data in the OSD memory 22, the LCD controller 13A reads pre-stored data from the other OSD memory 23 and displays it on the screen of the LCD, accordingly delay in the data output is not occurred by the read/write operations of the memories 22, 23.

For reference, by considering  $176 \times 220$  (1 pixel is constructed with three elements respectively describing R, G, B colors) pixel acknowledged by a provisional usage of a LCD panel for an IMT-2000 terminal, a memory of  $176 \times 220 \times 3\text{bit}$  as a size of one frame is used as the OSD memories 22, 23. Herein, by the LCD controller 13A, when the display operation is performed, a clock signal outputted from an oscillator (not shown) of the LCD driver 13 is used.

In the meantime, the clock signal is used in mode setting of 1 byte of data transmitted once in the I2C interfacing between the main CPU 11 and the LCD driver 13. The mode setting will now be described in detail with reference to accompanying Figure 3.

Figure 3 is a format view illustrating a mode setting in accordance with the present invention.

As depicted in Figure 3, the mode setting is classified into a display type

(2bit), an image/text type (1bit), a data type (1bit), an OSD memory selection bit (1 bit) and an EOFD (end of frame data) (1bit).

First, the display type (2bit) describes a kind of data to be played. The kind of data to be displayed is largely divided into an animation display, a text display with a still image background, only text display and a mode for register control for a LCD controller. In more detail, the memory of the LCD driver 13 is allocated according to the display type. Herein, by saving power of unused memory cells, a quantity of power consumption can be reduced. The memory allocation according to the display type will be described in detail with reference to accompanying Figures 5 ~ 7.

The image/text type (1bit) describes whether transmitted data is image data or text data. Image data is constructed as 3 bit, and text data is constructed as 1 bit.

The data type (1bit) describes a type of data, data type is largely divided into burst data, area data, line data and pixel data. Data write stream in accordance with the data type will be described in detail with reference to accompanying Figures 8A ~ 8H.

The OSD memory selection bit (1bit) is for making the main CPU 11 select each of two OSD memories of the LCD driver 13. The EOFD (end of frame data) (1bit) is for notifying the end of frame data. In more detail, the EOFD (1bit) is for coinciding a synchronous of time write data in the memory unit 13B with a time for reading contents stored in the memory unit 13B by the main CPU 11 and displaying it by the LCD controller 13A. When the main CPU 11 shows the EOF (end of frame) with the written data, the main CPU 11 does not access to the pertinent memory for a preset certain time, and for the preset certain time the LCD

controller 13A reads updated data of the memory by the main CPU 11 and displays it on the screen of the LCD.

Figure 4 illustrates an expression example about each data in accordance with the present invention.

As depicted in Figure 4, 3 bit image data describes 8 colors. In text data of 1 bit, "0" means a background data, "1" means text data, it is possible to select a color of background data and text data by using register control data as shown at Figure 9.

Figure 5 is a block diagram illustrating a memory unit for an animation mode in accordance with the present invention.

As depicted in Figure 5, both two memories 52, 53 of  $176 \times 220 \times 3$  bit of the LCD driver 13 are used. As described above, when the main CPU 11 writes data in the OSD memory 52, data pre-stored in the other OSD memory 53 is read and displayed on the screen of the LCD. When present recording data is the last data of a frame, by setting the EOFD bit as "1", a display controller (not shown) reads the pertinent data and informs that the pertinent data can be displayed on the screen of the LCD.

Figure 6 is a block diagram of a memory for a still image and a text display mode.

As depicted in Figure 6, between the two OSD memories 62, 63 of the LCD driver 13, the OSD memory 62 is used for storing a background still image. The other OSD memory 63 is divided into three regions, two regions having a size of  $176 \times 220 \times 1$  bit are selected as text regions, and text data is updated. Unused one regions is operated (set) as a power save mode.

The still image data and text data stored in the OSD memories 62, 63 are

displayed on the screen of the LCD as an overlay format through an overlay processing unit 64. A method for adjusting the control register is used in a command about the overlay. For example, when data is recorded on the one text memory, data of the other memory is read and is displayed on the screen of the LCD. Herein, when data to be written is the last data of a frame, by setting the EOFD bit as "1", the display controller reads the pertinent data and informs that the pertinent data can be displayed on the screen of the LCD.

Figure 7 is a block diagram illustrating a memory for a text display mode.

As depicted in Figure 7, in each OSD memory 72, 73, only the region of  $176 \times 220 \times 1\text{bit}$  is used for reading/writing a text, rest regions are operated (set) as power save regions. Herein, while the text data transmitted from the main CPU 11 is recorded on the one OSD memory, namely, the OSD memory 72, the text data pre-stored in the other OSD memory 73 is read and displayed on the screen of the LCD. In addition, when the recorded data is the last data of the frame, by setting the EOFD bit as "1", the display controller reads the pertinent data and informs that the pertinent data can be displayed.

For example, each OSD memory illustrated in Figures 5 ~ 7 is all same OSD memory, however it has different reference numeral according to the operation type (mode).

Figures 8A ~ 8H illustrate data formats about a method for writing data in an OSD memory according to control of a main CPU of a LCD system. In more detail, data is classified into 8 types in which kinds of data to be written is an image or a text and types of data is burst, area, line or pixel. Herein, Figures 8A ~ 8E illustrate examples of format for writing the image data. Hereinafter, each data write method will be described as below.

First, a write method of burst data will be described with reference to accompanying Figure 8A.

In the first place, in order to be suitable for an I2C standard, a slave address of a device (the LCD driver 13) is transmitted through a first byte. Because it is writing data, a 8th bit set as "0". A second byte is for transmitting contents about a mode setting. Because transmitted data is image data, an image/text bit is set as "1", and because a write type is a burst type, a data type is set as "00". In this case, because data of one frame is transmitted at one time, the EOFD bit is set as "1". A display type and an OSD memory selection bit are set so as to be corresponded to an access method of the present main CPU 11. And, 3 bit pixel data is transmitted from a third byte. In more detail, when the number of pixels of the used LCD is  $176 \times 220$ , 38720 data are transmitted, and after that, the transmission is stopped (finished). The above-mentioned write method can be used in transmission of an animation display and a still background image.

An area data write method will be described with reference to accompanying Figure 8B.

As well as Figure 8A, a slave address of the device is transmitted through a first byte. In case of data writing, a 8th bit is set as "0". As same with the above-mentioned method, a second byte is for transmitting contents about a mode setting, because the transmitted data is image data, an image/text bit is set as "1", and because a write type is an area type, a data type is set as "01". A display type and an OSD memory selection bit are set so as to be corresponded to a method for accessing to the present main CPU 11. A start address of an area is transmitted through a third byte. When the number of pixels of the used LCD is  $176 \times 220$ , because 16 bit address exists, a start address of 2 byte is transmitted. The last

address of the area is transmitted through a fourth byte. A start address of 2 byte is transmitted. From a fifth byte, pixel data of the selected area is transmitted and stopped. The above-mentioned write method can be used valuably when a small animation image is displayed or some part is updated or a small still image is used as a background.

A write method of line data will be described with reference to accompanying Figure 8C. As same with the above-mentioned method, the slave address of the device is transmitted through a first byte. It is also writing data, a 8th bit is set as "0". In a second mode setting byte, transmitted data is image data, the image/text bit is set as "1", and because the write type is a line type, data type is set as "10". A line address is transmitted through a third byte, when the number of pixels of the used LCD is  $176 \times 220$ , a line address of 8bit is transmitted. From a fourth byte, pixel data is transmitted. The transmission is stopped after transmitting 176 image data describable one line. As depicted in Figure 8B, the above-mentioned write method can be used valuably in partial update of an animation image or a still image. Herein, the update method is selected by a program language according to conditions.

A write method of pixel data will be described with reference to accompanying Figure 8D. A slave address of the device is transmitted through a first byte. Because it is writing data, a 8th bit is set as "0". In a second mode setting byte, because transmitted data is image data, an image/text bit is set as "1", and because a write type is pixel type, a data type is set as "11". An address of pixel is transmitted through a third byte. When the number of pixels of the used LCD is  $176 \times 220$ , because a 16 bit pixel address exists, a 2 byte address is transmitted. Pixel data is transmitted through a fourth byte. It is possible to update

up to two image pixels by using a byte. It is determined by the program language whether one pixel is updated or two pixels are updated at the same time. The above-mentioned write method can be used valuably in partial update of an animation image or a still image.

5 In the meantime, Figures 8E ~ 8H illustrate examples of a format for writing text data. First, a write method of burst data will be described with reference to accompanying Figure 8E.

10 A slave address of the device is transmitted through a first byte. Because it is writing data, a 8th bit is set as "0". In a second mode setting byte, because transmitted data is text data, an image/text bit is set as "0", and because a write type is a burst type, data type is set as "00". In this case, because data of one frame is transmitted at one time, the EOFD bit is set as "1". Text data is transmitted from a third byte. Each text data is constructed as 1 bit, when the number of pixels of the used LCD is  $176 \times 220$ , 38720 text data are transmitted.

15 The above-mentioned write method can be valuably used in update of all text data of one frame.

20 A write method of area data will be described with reference to accompanying Figure 8F. A slave address of the device is transmitted through a first byte. Because it is writing the data, a 8th bit is set as "0". In a second mode setting byte, because transmitted data is text data, an image/text bit is set as "0", and because a write type is an area type, data type is set as "01". A start address of the area is transmitted through a third byte. When the number of pixels of the used LCD is  $176 \times 220$ , because 16 bit address exists, a start address of 2 byte is transmitted. The last address of the area is transmitted through a fourth byte. The last address is 2 byte. From a fifth byte, text data of the selected area is

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transmitted and stopped. In the above-mentioned write method can be variously used in partial update of text data.

A write method of line data will be described with reference to accompanying Figure 8G.

5 First, a slave address of the device is transmitted through a first byte. Because it is writing data, a 8th bit is set as "0". In a second mode setting byte, because transmitted data is text data, an image/text bit is set as "0", and because a write type is a line type, a data type set as "10". An address of the line is transmitted through a third byte. When the number of pixels of the used LCD is 10  $176 \times 220$ , 8 bit line address is transmitted. From a fourth byte, text data is transmitted. 176 text data describable one line are transmitted and the transmission is stopped. The above-mentioned write method can be valuably used in partial update of text data as well as the method shown at Figure 8F.

15 A write method of pixel data will be described with reference to accompanying Figure 8H.

20 First, a slave address of the device is transmitted through a first byte. Because it is writing data, a 8th bit is set as "0". In a second mode setting byte, because transmitted data is text data, an image/text bit is set as "0", and because a write type is a pixel type, a data type is set as "11". An address of the pixel is transmitted through a third byte. When the number of pixels of the used LCD is  $176 \times 220$ , because 16 bit pixel address exists, 2 byte address is transmitted. And, text data is transmitted through a fourth byte. Herein, it is possible to update up to 8 text data by using one byte. At this point, the number of updated text data is determined by the program language. The above-mentioned write method can be 25 valuably used in the partial update of text data.

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Figure 9 is a write format view illustrating register control data in order to describe a method for writing register control data. In more detail, it illustrates a method for writing register control data.

First, an address of the device is transmitted through a first byte. Because it is writing data, a 8th bit is set as "0". A second byte is about a mode setting and an address of a register, in the register control, a first 2 bit is set as "11". And, the rest 6 bit are used as an address of the control register, in this case 64 control registers can exist. And, data to be written is transmitted to the register through a third byte.

By using the control register, a motion (active, standby, power down) mode is set, positions of OSD (on screen display) regions are selected, on/off of the selected OSD regions are determined or colors of a text and a background in the regions are selected. For reference, the rest control registers are selected after due consultation with manufactures of the LCD driver 13.

The LCD system in accordance with the present invention is for reducing power consumption of the display system, the present invention is not limited to the LCD system, it can be used for a display apparatus such as an organic electroluminescence, etc.

As described above, in the interface apparatus and the method thereof for the display system in accordance with the present invention, a video codec is not operated in a standby mode of the LCD system, because image (animation, still image and text) and text are displayed on the screen of the LCD through the I2C interface between the memory and the main CPU of the LCD driver, accordingly in the usage of the video codec power consumption is 20 times smaller than a quantity of power consumption in the conventional art. In more detail, by using the

interface apparatus and the method thereof for the display system in accordance with the present invention for a portable terminal such as an IMT-2000 terminal, a PDA (personal digital assistant), etc., a quantity of power consumption in the standby state is 20 times smaller than a quantity of power consumption in the conventional art.

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